SSVEO IFA List

Date: 02/27/2003

STS - 57, OV - 105, Endeavour (4)

Time: 04:11:PM

Tracking No	Time	Classification	Documentation				Subsystem
MER - 0	**MET:**	Problem	**FIAR**	B-FCE-029-F070	**IFA**	STS-57-V-01	C&T - Audio
INCO-01	**GMT:**		**SPR**		**UA**		**Manager:**
			IPR	61V-0003	**PR**		
							Engineer:

Title: MS1 & MS2 Intercom Transmit Levels Low with Intermittent Dropouts during Ascent. (ORB)

Summary: DISCUSSION: Mission Specialist 1 (MS1) and Mission Specialist 2 (MS2) experienced intermittent intercommunication (ICOM) problems during ascent that began approximately 4 to 5 minutes after liftoff. Voice transmissions from both crewmembers were intermittent during the reported anomaly period and a "popping" noise was heard several times before, during, and after the reported anomaly when a taped recording of the event was reviewed. Both crewmembers later reported that their ICOM reception capability was not affected.

The crew attempted to troubleshoot the anomaly by first switching to a backup audio terminal unit and then to the number 2 audio central control unit. Neither action restored ICOM transmit capability for the two crewmembers, and the nominal ascent configuration was then restored. Nominal ICOM transmission capability returned without further action prior to main engine cutoff (MECO). Ground analysis during the flight identified several possible causes, and an entry configuration was selected that would minimize the potential effects of any of these failure modes. The anomaly did not recur during entry. Postflight troubleshooting at KSC showed that the anomaly could be repeated by grounding the exposed knurled metal part of the six-foot ICOM recorder background-noise input cable J2 connector with the system in the ascent configuration. Testing performed on separate hardware in the JSC Building 44 Audio Laboratory Reverberation Chamber was able to repeat this failure mode when shorting the exposed metal part of the J2 connector to any grounded structure or panel. The ascent configuration for this mission had the MS1 and MS2 headset interface units (HIU's) and the ICOM recorder connected to the multiple headset adapter (MHA). In this configuration, the exposed knurled metal part of ICOM recorder background-noise input cable J2 connector and the HIU microphone lines were all electrically connected to a summing amplifier terminal in the MHA that is normally biased at approximately 14 Vdc. Shorting the exposed metal part of the ICOM recorder background-noise input cable J2 connector to any grounded structure or panel would cause the MHA summing amplifier to become grounded. This does not damage the amplifier, but it does cause the amplifier to stop working. During laboratory testing, a popping noise and a loss of voice transmission occurred each time the exposed metal part of ICOM recorder background-noise input cable J2 connector was touched to an electrically grounded point. For ascent, the six-foot background-noise microphone cable was plugged into the ICOM recorder background-noise input cable, and about half of the twelve- foot assembly was coiled up and tied off out of the crew's way. The interfacing J2 connector was bundled into the coiled-up cable assembly.

Nominal ascent vibration probably caused the connector to contact a grounded panel or structural surface which induced the observed ICOM failure. Since all of the ICOM recorder background-noise input cables in service have exposed knurled metal on the J2 connector, the cause of this failure is considered to be a design deficiency. The connectors will be modified to extend existing strain-relief tubing so that the tubing will completely cover and insulate the metal part of the connector. The ICOM recorder background- noise input cable is the only audio cable in the ICOM system which has an uninsulated connector. For STS-51, the connector will be wrapped with electrical tape to provide the necessary insulation. CONCLUSION: The cause of the anomaly was an ICOM recorder background-noise input cable design deficiency. Exposed metal at the cable's J2 connector where the background-noise microphone connector plugs into the ICOM recorder input cable probably contacted an electrically grounded point on a panel or structural surface, causing the MHA summing amplifier to become grounded and to stop operating. The MHA summing amplifier was not damaged. CORRECTIVE_ACTION: All ICOM recorder cables which will serve as input cables from the background-noise microphone will be modified to extend existing strain-relief shrink tubing so that the tubing will completely cover and insulate the metal part of the cable's J2 connector. The ICOM recorder background-noise input cable is the only audio cable in the ICOM system with an uninsulated connector. For STS-51, the connector will be wrapped with electrical tape to provide the necessary electrical insulation. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-57-V-02	Atmospheric Rev
EECOM-01	**GMT:**		**SPR** None	**UA**	**Manager:**
			IPR	**PR** ECL-5-05-0320	
					Engineer:

Title: PPO2 Sensor B Biased Low (ORB)

Summary: DISCUSSION: During the mission, PPO2 sensor B consistently indicated approximately 0.14 psi to 0.18 psi lower than its counterparts, sensors A and C. Once it reached the 0.18 psi bias, sensor B stabilized at that level for the remainder of the flight. The prelaunch bias between sensor B and sensors A and C was between 0.06 psi and 0.08 psi (Launch Commit Criteria and Flight Rules require a bias of less than 0.15 psi). Once sensor B's bias fell out of the allowable range, as specified in the Flight Rules, the sensor was inhibited from onboard computation. Sensor B was a -1065 design series sensor. At the time of installation, sensor B had approximately 4000 hours of operational usage. Sensors with greater than 4500 hours of usage are not selected for flight installation.

CONCLUSION: The time accumulated on sensor B's internal components may have caused an out-of-range bias in its pressure readings. After attaining a total bias of 0.18 psia the sensor output stabilized and tracked the remaining two sensors for the duration of the flight. CORRECTIVE_ACTION: Sensor B was removed and replaced per the standard changeout schedule performed after each flight. Since sensor B was one of the -1065 series sensors, which are being phased out of the program, a failure analysis was considered both unnecessary and not cost effective. Consequently, no conclusions may be drawn concerning the failure mode. In the future, all -1065 sensors will be replaced with the new design -3165 sensors. The -3165 series is a long life sensor (minimum 12000 hrs) that has successfully completed qualification testing. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. Sensors installed for future missions will be -3165 series.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-57-V-03	FC/PRSD
EGIL-01	GMT:		SPR 57RF05	UA	Manager:
			IPR	PR UA-5-A0002	
					Engineer:

Title: PRSD O2 Manifold 1 Isol Valve Failed To Close. (ORB)

Summary: DISCUSSION: At approximately 172:19:26 G.m.t., the O2 manifold 1 isolation valve failed to close when commanded by the crew to configure the PRSD system for the sleep period. A second attempt to close the valve about one minute later was also unsuccessful. The crew successfully closed the O2 and H2 manifold 2 isolation valves to establish the sleep-period configuration, with O2 being supplied from tank 4 at -260?F. An on-orbit test of the O2 manifold 1 isolation valve was performed at approximately 180:04:04 G.m.t. The crew reported that the valve closed without delay, and O2 was being supplied from tank 3 at -173?F.

The O2 manifold 1 isolation valve has failed to close on two previous flights of OV-105. During the first flight of OV-105 (STS-49), three attempts to close the valve on flight day 1 failed with O2 being supplied from both tanks 1 and 2 at -272?F. On flight day 9, two additional attempts failed with O2 being supplied from tank 1 at -175?F. This anomaly could not be reproduced during ground testing, and no electrical discrepancies were reported. During the third flight of OV-105 (STS-54), the first attempt to close the valve on flight day 3 failed, but a second attempt was successful after holding the command switch in the closed position for two seconds. O2 was being supplied from tanks 1 and 2 with both tanks at -180?F during this operation. Manifold isolation valves are solenoid latching valves. Energizing the opening coil of the solenoid pulls the plunger into the coil and opens the valve. A permanent magnet 'latches' the valve open, allowing removal of power from the opening coil. Energizing the closing coil neutralizes the latching magnet's field allowing the closing spring to push the plunger and thus reseat the valve. Actuation of the single electrical switch that indicates valve position depends on poppet movement. The switch closes when the valve reaches the full-open position and opens when the valve reaches the full-closed position. An identical O2 manifold isolation valve experienced similar in-flight failures on OV-104 and was removed for failure analysis. The anomaly was consistently repeated when attempts were made to close the valve under cold- flow conditions at temperatures below -75?F. At warmer temperatures, valve operation was nominal. Further testing after valve disassembly showed that the magnetic latching force was higher than the drawing specification. When the valve's magnetic latch was remagnetized in accordance with the drawing specifications, the valve operated within specified time limits down to -200? F, the lowest temperature sustainable by the GN2 test fixture used. The failure of the OV-104 manifold isolation valve is being attributed to an inability of the closing spring to overcome the excessive magnetic latching force under cold-flow conditions. Continuing failure analysis is focusing on the influence of temperature on the failure mode. Changes in valve material permeability, strength or distribution of magnetic fields, closing spring force-displacement constant, and thermal expansion are among the factors which may be contributing to the onset of failure at low temperatures. The suspected cause of the OV-104 O2 manifold isolation valve may be common to all manifold isolation valves and other solenoid latching valves in the PRSD subsystem that are subjected to low temperatures, including the fuel cell reactant valves and the ECLSS O2 supply valves. All PRSD solenoid latching valves are similar in design and are manufactured by the same vendor. All PRSD manifold isolation valves, fuel cell reactant valves, and ECLSS O2 supply valves are installed on valve panel assemblies that are removed and replaced as assemblies when maintenance is required. PRSD O2 valve panel

number 1 has been replaced on OV-105 by a spare assembly that was successfully tested under cold-flow conditions, and installation retests have been satisfactorily completed. The removed valve panel assembly has been sent to the NASA Shuttle Logistics Depot (NSLD) for a failure analysis of the O2 manifold 1 isolation valve that will include cold-flow testing followed by valve disassembly and component-level testing. Final corrective action will be documented in CAR 57RF05-010. The O2 and H2 manifold isolation valves are being used to configure the PRSD system for sleep periods. This practice has adequately screened the manifold isolation valves installed on OV-102 and OV-103, as well as the OV-105 manifold isolation valves which were not replaced after STS-57. Fuel cell reactant valves are not normally operated in-flight unless a fuel cell is shut down, and only six reactant valves have been operated on-orbit since return-to-flight to support the fuel cell shutdown/startup development test objective. One of these reactant valves, the fuel cell 3 H2 reactant valve on OV-105, failed to provide a closed indication when operated during STS-57. PRSD H2 valve panel number 2 was removed and sent to NSLD for failure analysis of the reactant valve and was replaced with a cold-flow tested assembly. ECLSS O2 supply valves only reach temperatures that would adequately screen valves for the suspected failure mode during periods of heavy O2 demand from a cold supply tank such as cabin presure changes for extravehicular activity. One ECLSS O2 supply valve was satisfactorily screened on-orbit following cabin repressurization during STS-51, and one other valve was successfully cold-flow tested prior to installation on OV-105. All subsequent missions will be flown with manifold isolation valves that will have been screened by successful on-orbit use or by pre-installation cold-flow testing. A plan has been developed to remove all PRSD valve panel assemblies for cold-flow testing during OMDP beginning with OV-104 because on-orbit operations present too few opportunities to accomplish screening of fuel cell reactant valves and ECLSS O2 supply valves. Spare valves and panel assemblies will also be tested under cold-flow conditions. Acceptance test procedures are being modified to include cold-flow testing for new valves and assemblies will also be tested under cold-flow conditions. Acceptance test procedures are being modified to include cold-flow testing for new valves and assemblies. CONCLUSION: The anomaly was probably caused by an inability of the valve closing spring to overcome the force of the magnetic latch when the valve was commanded closed at cold temperatures because the magnetic latching force may have been set too high. This conclusion is based on the results of a failure analysis being performed on an identical valve that experienced similar anomalies. Fuel cell reactant valves and ECLSS O2 supply valves may also be susceptible to this failure mode because these valves employ a similar design. CORRECTIVE_ACTION: PRSD O2 valve panel number 1 was replaced by a spare assembly that was successfully tested under cold-flow conditions, and installation retests were satisfactorily completed. The removed valve panel assembly was sent to the NSLD for a failure analysis of the O2 manifold 1 isolation valve that will include cold-flow testing followed by valve disassembly and component-level testing. Final corrective action will be documented in CAR 57RF05-010. Cold-flow testing will be performed on all PRSD valve panel assemblies during OMDP. Spare valve panel assemblies will be cold-flow tested prior to installation. Acceptance test procedures are being changed to include cold- flow testing of new solenoid latching valves and valve panel assemblies. EFFECTS_ON_SUBSEQUENT_MISSIONS: All O2 and H2 manifold isolation valves in service will have been screened by successful on-orbit use or by pre- installation cold-flow testing for all subsequent missions. If a manifold isolation valve fails to close on-orbit, crew procedures permit using the other manifold isolation valve. The most severe case would be a failure-to- close should external leak isolation be required during ascent, as this condition would result in depletion of reactants and loss of two fuel cells. No external leak requiring manifold isolation valve use has occurred in the history of the program.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR** JSC EC 0455F DR	**IFA** STS-57-V-04	GFE
EVA-01	**GMT:**		BE 130089	**UA**	**Manager:**

			SPR	**PR**	
			IPR		**Engineer:**

Title: EVA Waist Tether Hook Failure (GFE) (GFE)

Summary: DISCUSSION: During the extravehicular mobility unit (EMU) checkout prior to the extravehicular activity (EVA), the crew discovered that the waist tether small tether hook (ser. no. 181) would not lock closed. The lock/lock buttons would pop out but the tether hook would not lock. An in-flight maintenance (IFM) procedure was developed to replace the tether hook with a shackle taken from one of the service and cooling umbilical (SCU) tethers. The IFM was successful and the EVA proceeded without further incident.

CONCLUSION: Operation of the tether hook was verified during the preflight inspection acceptance (PIA) prior to shipment to KSC. The failure was probably caused during ground handling (post PIA) by extreme loads being applied to the keeper locking mechanism without simultaneously depressing the two lock/lock buttons. This subsequently overloaded the Vespel plungers and compression spring within the internal locking mechanism, causing severe fragmentation and distortion of these components. Since the loads required to cause this type of damage are probably much greater than a crewmember could exert with a gloved hand, the damage probably occurred during preflight handling. CORRECTIVE_ACTION: Ground handling procedures have been clarified and additional steps have been added to the appropriate operational maintenance instructions (OMI), and to the PIA, to ensure that the tether hooks are not damaged prior to or during installation in the Orbiter. A redesign effort is also under way to assess the use of more robust materials for the internal locking mechanism. In addition, the Flight Data File crew procedures will be modified to include checkout of the tether hooks prior to beginning an EVA. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. Redundant tether hooks are attached to the EMU, and their operation may be verified prior to EVA.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-57-V-05	C&T - S-Band
INCO-03	**GMT:**		**SPR** 57RF02	**UA**	**Manager:**
			IPR 61V-0005	**PR**	
					Engineer:

Title: S-Band Intermittent Losses of Forward and Return Link Using the Lower Left Quad Antenna. (ORB)

Summary: DISCUSSION: The S-Band system did not establish a forward link with the East Tracking and Data Relay Satellite (TDRS) when acquisition of signal (AOS) was expected on orbit 56 at 176:03:57 G.m.t. Approximately 38 minutes later, a nominal forward link was established when another S-Band antenna was automatically selected. Data review and subsequent flight operations revealed numerous other short-duration forward link dropouts while using the lower left antenna with the S-Band system configured to use both transponders and amplifiers and while operating in both high- and low-frequency modes. Data indicated that return link performance was nominal.

The anomaly was repeated during ground troubleshooting, and a hot connector (connector P2) was found on cable W536 in avionics bay 3A leading to the lower left antenna. The cable was replaced and the system was retested with satisfactory results. Failure analysis will be performed on the faulty cable assembly at Rockwell-Downey to determine the cause of the anomaly. Failure analysis will include a 360? X-ray examination and connector assembly dissection. Failure analysis results and final corrective action will be documented in CAR 57RF02-010. CONCLUSION: Connector P2 on cable W536 between the S-Band antenna switch assembly and the lower left antenna overheated and caused an intermittent signal degradation. CORRECTIVE_ACTION: Cable W536 was replaced and sent to Rockwell-Downey for failure analysis. The S-Band system was retested with satisfactory results. Failure analysis results and final corrective action will be documented in CAR 57RF02-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-57-V-06	FC/PRSD
EGIL-03	GMT:		SPR 57RF03	UA	Manager:
			IPR 61V-0004	PR	
					Engineer:

Title: FC3 H2 React Valve Failed To Close. (ORB)

Summary: DISCUSSION: The fuel cell 3 (FC3) H2 reactant valve open indication remained on after the FC3 reactant valves were commanded closed at approximately 177:11:51 G.m.t., following the FC3 shutdown that was being performed as a development test objective (DTO). The FC3 O2 reactant valve, commanded by the same onboard switch, indicated nominal closure. The two valves were commanded open, and on a second attempt to close the valves, the FC3 H2 reactant valve open indication once again remained on. Available data could not conclusively show whether the valve had actually closed, so the extended shutdown DTO was aborted, the reactant valves were commanded open, and FC3 was restarted.

Shortly after landing, FC3 was shut down and the reactant valves were commanded closed. Both reactant valves indicated nominal closure on the first attempt. Ground troubleshooting could not reproduce the anomaly, and no electrical discrepancies have been reported. Fuel cell reactant valves are solenoid latching valves. Energizing the opening coil of the solenoid pulls the plunger into the coil and opens the valve. A permanent magnet 'latches' the valve open, allowing removal of power from the opening coil. Energizing the closing coil neutralizes the latching magnet's field, allowing the closing spring to push the plunger and thus reseat the valve. Actuation of the single electrical switch that indicates valve position depends on poppet movement. The switch closes when the valve reaches the full-open position and opens when the valve reaches the full- closed position. The voltage drop on essential bus 2CA when the FC3 H2 reactant valve failed to indicate closed was consistent with the historical signature of successful reactant valve closures. This suggests that both the H2 and O2 reactant valve closing coils were being supplied with nominal current, therefore an intermittent failure of the closing coil circuit or the valve command circuit is not suspected. One possible cause of the anomaly is an intermittent failure of the valve position indication circuit. This possibility will be investigated during failure analysis, but is considered unlikely, because historically the sealed switch assemblies used for PRSD solenoid latching valve position indication have not failed intermittently. Another possible cause is derived from three recent failures of PRSD manifold isolation valves to close when commanded. Manifold isolation valves are similar in design and are produced by the same vendor as the reactant valves. Failure analysis being performed on an O2 manifold isolation valve that failed to close on OV-104 has shown that the valve consistently failed to close at temperatures below -75?F. At warmer temperatures, valve operation was nominal. The magnetic latching force was found to have been set higher than the drawing specification. When the valve's magnetic latch was remagnetized in accordance with drawing specification, the valve operated within specified time limits down to -200?F, the lowest temperature sustainable by the GN2 test fixture used. The failure of the OV-104 manifold isolation valve is being attributed to an inability of the closing spring to overcome the excessive magnetic latching force under cold-flow conditions. Continuing failure analysis is focusing on the influence of temperature on the failure mode. Changes in valve material permeability, strength or distribution of magnetic fields, closing spring force-displacement constant, and thermal expansion are among the factors which may be contributing to the onset of failure at low temperatures. The suspected cause of the OV-104 O2 manifold isolation valve may be common to all manifold isolation valves and other solenoid latching valves in the PRSD subsystem that are subjected to low temperatures, including the fuel cell reactant valves and the ECLSS O2 supply valves. All PRSD solenoid latching valves are similar in design and are manufactured by the same vendor. All PRSD fuel cell reactant valves, manifold isolation valves, and ECLSS O2 supply valves are installed on valve panel assemblies that are removed and replaced as assemblies when maintenance is required. PRSD H2 valve panel number 2 has been replaced on OV-105 by a spare assembly that was successfully tested under cold-flow conditions, and installation retests have been satisfactorily completed. The removed valve panel assembly has been sent to the NASA Shuttle Logistics Depot (NSLD) for a failure analysis of the FC3 reactant valve that will include cold-flow testing followed by valve disassembly and component-level testing. Final corrective action will be documented in CAR 57RF03-010. Spare reactant valves and PRSD valve panel assemblies will be cold-flow tested prior to installation. Acceptance test procedures are being modified to include cold-flow testing for new PRSD solenoid latching valves and panel assemblies. A plan has been developed to remove all PRSD valve panel assemblies for cold-flow testing during OMDP beginning with OV-104 because on- orbit operations present too few opportunities to accomplish screening of fuel cell reactant valves and ECLSS O2 supply valves. Fuel cell reactant valves are not normally operated in flight unless a fuel cell is shut down and must be isolated. Five of the six reactant valves that were commanded in flight to support the fuel cell shutdown/startup DTO operated nominally. Three cold- flow tested reactant valves were installed on OV-105 when the two PRSD valve panel assemblies were replaced, and the FC2 and FC3 O2 reactant valves operated nominally in flight in support of the DTO. On OV-105, only the FC1 H2 reactant valve has not been tested at cold temperatures. The FC1 H2 and O2 reactant valves on OV-103 were also successfully operated in support of the DTO during STS-51. All remaining fuel cell reactant valves will be cold-flow tested during OMDP. ECLSS O2 supply valves only reach temperatures that would adequately screen valves for the suspected failure mode during periods of heavy O2 demand from a cold supply such as cabin pressure changes for extravehicular activity. One ECLSS O2 supply valve was satisfactorily screened on-orbit following cabin repressurization during STS-51, and one other valve was successfully cold-flow tested prior to installation on OV-105. The O2 and H2 manifold isolation valves are being used to configure the PRSD system for sleep periods. This practice has adequately screened the manifold isolation valves installed on OV-102 and OV-103, as well as the OV-105 manifold isolation valves which were not replaced after STS-57. OV-104 manifold isolation valves will be cold-flow tested during OMDP. CONCLUSION: The anomaly was probably caused by an inability of the valve closing spring to overcome the force of the magnetic latch when the valve was commanded closed at cold temperatures because the magnetic latching force may have been set too high. This conclusion is based on the results of a failure analysis in work on a similar O2 manifold isolation valve which failed to close. CORRECTIVE_ACTION: PRSD H2 valve panel number 2 was replaced by a spare assembly that was successfully tested under cold-flow conditions, and installation retests were satisfactorily completed. The removed valve panel assembly was sent to the NSLD for a failure analysis of the FC3 H2 reactant valve that will include cold-flow testing followed by valve disassembly and component-level testing. Final corrective action will be documented in CAR 57RF03-010. Cold-flow testing will be performed on all PRSD valve panel assemblies during OMDP. Spare valve panel assemblies will be cold-flow tested prior to installation. Acceptance test procedures are being changed to include cold- flow testing of new solenoid latching valves and valve panel assemblies. EFFECTS_ON_SUBSEQUENT_MISSIONS: Fuel cell reactant valves normally remain open during flight, and are only closed to secure a shutdown fuel cell or to isolate external or crossover leakage. The most severe case would be a failure-to-close should external leak isolation be required, as this condition would cause depletion of one reactant storage tank. No external leakage requiring reactant valve use has occurred in the history of the program. Failure of both fuel cell reactant valves or failure of the H2 reactant valve combined with failure of the dual gas regulator must occur for a fuel cell crossover failure to become severe.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-57-V-07	D&C - Lighting
EGIL-02	**GMT:**		**SPR** A: 57RF04, B: 57RF10, C: 57RF11	**UA**	**Manager:**
				PR	
			IPR A: 61V-0006B: 61V-0014C: 61V-0015		**Engineer:**

Title: Payload Bay Flood Light Failures: A) MID STBD, B) AFT STBD, C) MID PORT. (ORB)

Summary: DISCUSSION: During payload bay floodlight operations, a remote power controller (RPC) overcurrent trip signature was observed on main C mid power controller 3 (MPC 3). There are two floodlights, the mid starboard and the aft port, that are controlled by this circuit. At the time, it could not be determined which of these lights caused the RPC trip. During the EVA, an RPC trip was again observed on mid main C. This time only the mid starboard floodlight was powered (the port aft floodlight was switched off). The EVA crew verified that the mid starboard floodlight was not illuminated.

During the final payload bay door closing, the crew powered the forward bulkhead, aft starboard, and mid port floodlights. Following the door closure, the crew powered down the forward bulkhead floodlight first. When the forward bulkhead floodlight was switched off, the payload bay became dark, indicating that both the aft starboard and mid port floodlights had failed to illuminate. Following the mission, the floodlights were inspected and signs of arcing were noted on the mid starboard floodlight, which was replaced. In an effort to isolate the failure of the aft starboard floodlight, the wires to this floodlight were swapped with those of the forward port floodlight at the floodlight electronics assembly (FEA) 1. The failure moved to the forward port floodlight indicating a failure in FEA 1. The mid port floodlight assembly was removed and sent to NSLD for testing. Using the test ballast at NSLD, its lamp remained hard to start. It is possible that a low output voltage from the ballast contributed to the problem. FEA 1 is also used to drive the mid port floodlight. The FEA was replaced due to the aft starboard failure and a new mid port floodlight assembly was found that worked properly with the replacement FEA. The output voltage to the mid port floodlight will be checked when the removed FEA is repaired. CONCLUSION: A) The RPC trip was caused by arcing in the mid starboard floodlight. B) A failure in FEA 1 was the cause of the aft starboard floodlight not illuminating. C) The most probable cause of the mid port floodlight failure was a combination of low output voltage from FEA 1 and a hard-to-start lamp.

CORRECTIVE_ACTION: The FEA 2 and the mid starboard floodlight assembly were replaced due to the arcing seen in the mid starboard floodlight. FEA 1 was replaced due to the failure of the aft starboard floodlight. The mid port floodlight assembly was replaced due to the suspected hard-to-start lamp.
EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-57-V-08	EPD&C - Hardwar
EGIL-05	**GMT:**		**SPR** 57RF13	**UA**	**Manager:**
			IPR	**PR** DDC-0046	x31719
					Engineer:

Title: MCA Power AC3 Mid 4 Circuit Breaker Anomaly (ORB)

Summary: DISCUSSION: On flight day 4 at ~ 176:21:24 G.m.t., the crew reported that the motor control assembly (MCA) logic power AC3 3-phase Mid 4 circuit breaker(CB) 13 on panel MA73C would not close. The crew did not try to reset the CB per the crew procedures for an ac CB that had tripped open. The CB was open and being closed as a part of remote manipulator system (RMS) preparations for stowage. The crew was instructed to leave the CB out and continue with the RMS stowage using single motors. The ac bus-voltage data were reviewed and found to have no unusual signatures. The crew was then given the go-ahead to push the CB in; however, the breaker did not stay latched. The crew member was instructed to push the CB in firmly; the CB closed and remained latched. The ac bus voltage data were again reviewed and showed no unusual signatures. The flight controllers developed a plan to test the MCA power AC3 bus by opening and closing a right payload bay vent door. However, the open command was sent without removing the closed command; this caused a phase-to-phase short on the bus. The CB opened again as a result of the short. The vent door commands were reset and the crew was given the approval to reset the CB. The Orbiter data were reviewed and no anomalous signatures were noted.

Postflight at KSC, CB13 was tested. The test consisted of cycling the CB through open and close 6 times utilizing a force gauge. On July 16, 1993, the force required to close CB13 was 13 lb, and to open was 10 lb. On July 22, 1993, CB13 was cycled open and closed 5 times with the forces ranging between 10 to 12 lb to open and 12 lb to close the CB each time. The average reset force for this type of CB has been 9.5 lb to 10 lb with a range of 8.5 lb to 11 lb. The drawing specification for the actuation force states that, "manual actuation force shall not exceed 12 lb for pull-out and 12 lb for reset." KSC removed panel MA73C and shipped the hardware to NASA Shuttle Logistics Depot (NSLD) for testing and refurbishment. The panel is scheduled to be installed during the week ending August 8, 1993. The failure history of circuit breaker's part number MC454-0032-xxxx was reviewed. Five Corrective Action Reports (CAR's) have been written to address two failure modes, a fails to conduct and a fails to close. Of the CAR's written, none fit the operational problems experienced on STS-57. CONCLUSION: The MCA logic power AC3 3-phase mid 4 CB 13 on panel MA73C required a force that exceeded drawing specification to close. CORRECTIVE_ACTION: The panel MA73C was sent to NSLD and CB 13 was removed for testing and refurbishment or replacement. Troubleshooting and teardown analysis will be documented on IM57RF-13.
EFFECTS_ON_SUBSEQUENT_MISSIONS: None

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-57-V-09	INST
PROP-01	GMT:		SPR 57RF06	UA	Manager:
			IPR	PR DDC-5-05-0047	
					Engineer:

Title: RJDA 1 L1/R1 Manifold Driver Switch Failure. (ORB)

Summary: DISCUSSION: During the group B power-down procedure at 175:18:21:21 G.m.t. (03:05:13:59 MET), the reaction jet driver aft (RJDA) 1B L1/R1 manifold driver toggle switch was switched to the "off" position. This switch is a four-pole, two-position toggle switch. The available status measurements indicated that all off position switch contacts were closed. At 175:18:21:22 G.m.t. (03:05:14:00 MET) the RJDA 1 L1/R1 driver command A went to high indicating that one of the four-pole "on" position contacts had closed. The other available status measurements indicated that the remaining poles were still in the off position. Since the switch was indicating that one of the on position contacts had closed while the switch was in the off position, it was assumed that there was contamination in the switch that caused the anomalous indication.

Following the mission, panel O15 was removed from the vehicle and sent to NSLD for repair. At NSLD, the RJDA 1B switch was removed and replaced. At Rockwell/Downey, a functional test of the switch could not repeat the anomaly. An X-ray of the switch did not show any contamination inside the switch. Continuing the failure analysis, the switch was then cut open. An inspection of the switch body revealed a clump of pure copper shavings and individual copper flakes. This is the first occurrence of copper contamination being found in a switch of this type. Over 24 switches have been opened since 1975. As there are no internal switch components that are made of copper, the copper shavings are not a result of normal switch operation and were probably introduced during the manufacturing process. Most likely, in the zero-g environment, these copper shavings formed an electrical path between two switch contacts, causing the anomalous condition observed during the flight. The results of any additional analysis will be documented on CAR 57RF06-010. CONCLUSION: The most likely cause of the anomaly is a short-circuit condition caused by copper shavings within the switch body. The copper shavings were most likely introduced into the switch during the manufacturing process. CORRECTIVE_ACTION: The switch has been replaced and a complete functional test has been performed on the switch panel O15. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. Since this is the first occurrence of this type of contamination this is not considered a generic problem.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-57-V-10	INST
GNC-01	GMT:		SPR 57RF12	UA	Manager:
			IPR	PR DIG-0044	x31514
					Engineer:

Title: SPI Speedbrake Command Bias (ORB)

Summary: DISCUSSION: During the dedicated display/head-up-display portion of the flight control system checkout (~ 179:07:15:45 G.m.t), the crew reported the surface position indicator (SPI) speedbrake command indication was biased low. The SPI speedbrake command indication was tested in both the low and high ranges. During the checkout, the low range test of 20 percent indicated 13 percent (7 percent low) and the high range test of 30 percent indicated 23 percent (7 percent low).

The indicator being biased low did not impact entry because the true value of the speedbrake command can also be seen on vertical situation displays 1 and 2 during Major Mode 305. During turnaround testing prior to the STS-57 flight, the SPI speedbrake command indication was noted by KSC personnel to be near its requirement specification limits of +/-5 percent of commanded (indication read 5% low). To verify that the Multiplexer/Demultiplexer (MDM) was operating correctly postflight, KSC performed a built-in test equipment (BITE) checkout of the MDM. This test isolated the SPI as the failed hardware. The SPI was removed postflight and sent to the NASA Shuttle Logistics Depot (NSLD) for testing and refurbishment. There is no known previous history of failures of this type. CONCLUSION: The SPI was biased low and will be refurbished at NSLD for a return-to-flight. CORRECTIVE_ACTION: SPI was removed and sent to NSLD for refurbishment. EFFECTS_ON_SUBSEQUENT_MISSIONS: None

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Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR** RMS-1323	**IFA** STS-57-V-11	undefined
PDRS-02	**GMT:**		**SPR**	**UA**	**Manager:**
			IPR None	**PR**	
					Engineer:

Title: RMS to Payload Power Transfer Failure (RMS)

Summary: DISCUSSION: After the EURECA payload was grappled with the remote manipulator system (RMS), the crew reported no data was received at the standard switch panel. This is indicative of a failure to transfer power from the Orbiter to the payload through the RMS standard end effector J411 electrical connector (SPEE connector). Analysis of downlink video subsequently showed that the J411 connector was not in the proper position. This was due to the J411 connector being installed inverted. Power transfer to the payload was later established via the remotely operated electrical umbilical (ROEU).

CONCLUSION: The Orbiter and EURECA electrical connection could not be established because of the improperly installed J411 connector, which precluded the transfer of power to the EURECA. The improper installation was due to a manufacturing error at the vendor's facility. CORRECTIVE_ACTION: Manufacturing drawings will be changed to clarify the proper installation of the J411 connector. A special tool will also be built to check proper installation of the J411 connector, both during acceptance test program (ATP) and during KSC RMS preflight processing. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. The J411 connector configuration will be verified prior to flight. All other end effectors have been checked out and correct J411 connector installation has been verified.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-57-V-12	OI - Sensors
PROP-02	GMT:		SPR 57RF21	UA	Manager:
			IPR 61V-0012	PR	x31719
					Engineer:

Title: LRCS Crossfeed 3/4/5 Switch Talkback (ORB)

Summary: DISCUSSION: Following the first landing wave-off, the reaction control subsystem (RCS) system was reconfigured at 180:13:22 G.m.t. The left reaction control system (RCS) OX/FU crossfeed valve 3/4/5 talkback, panel 07, indicated barberpole when it should have indicated closed after the switch was moved from GPC to Closed. The crew reported a barberpole indication. Subsequent cycling of the switch from Closed to GPC to Closed did not change the barberpole indication. Data review verified the valve was in the closed position before and after the switch throw from GPC to Closed and during the switch cycling to clear the barberpole. Approximately two hours later (180:15:09 G.m.t.), the crew reported the talkback correctly indicated closed.

Postflight troubleshooting could not duplicate the failure on the ground. KSC troubleshooting attempted to recreate the anomaly by placing the valve in a closed position and cycling the switch from GPC to Closed several times. The control power to the indicator was cycled on and off several times with no recurrence of the anomaly. A breakthrough box was installed to check the threshold of the talkback. The measured voltage to actuate the indicator to full travel was within the specification requirements. In addition, the resistance readings of the event indicator coil were nominal. The signal from the valve microswitch to the event indicator was tested, and the test results indicated a good signal from the microswitch. The failure history of the event indicator MC432-0222-00XX has been reviewed. There have been nine Corrective Action Records (CAR's) written for field or flight failures. The failure modes are an incorrect indication and slow- indicator movement. This particular IFA is similar to CAR KB2459 which was an incorrect indication failure mode. The cause was determined to be an intermittent open winding on the event indicator coil. In addition, this anomaly is similar to CAR AD8920 in which an indicator was in the barberpole position when it should have been in the closed position. The cause for this failure was not determined because the indicator was lost at the NSLD after removal from the panel. CONCLUSION: The most probable cause is an intermittent open circuit on the event indicator coil. CORRECTIVE_ACTION: Ground troubleshooting was unable to repeat the flight problem or discover any unusual signatures that may have caused the flight problem. The hardware will be flown as is and its performance will be monitored. This problem is being documented under CAR 57RF21-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None, however if this problem were to recur, the ground has insight to the valve position.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-57-V-13	OMS/RCS
PROP-03	GMT:		SPR 57RF09	UA	Manager:
			IPR	PR RP04-0361	x39030

Engineer:

Title: R5D Heater Failed On (ORB)

Summary: DISCUSSION: The reaction control subsystem (RCS) vernier thruster R5D's injector temperature cooldown response during low vernier thruster activity periods, including the RCS hotfire on flight day 8 indicated a failed-on thruster heater. The injector temperatures did not drop below 180?F. The condition was further confirmed when the vernier heaters were turned off prior to entry. The R5D cooldown rate converged with the other vernier thruster cooldown rates. The thruster functioned normally with the heater failed-on. All other vernier thrusters exhibited normal temperature traces.

Postflight troubleshooting started with the removal of the thruster from the vehicle. Testing of the thruster heater system verified the heater was failed on. The vendor replaced the heater controller on the thruster. The thruster was retested with good results, and the thruster was reinstalled on the vehicle. The failed-on heaters experienced with OV-105 built thrusters on STS-49, 50, and 55 are not related to this vernier heater failure. The heater controller for R5D was manufactured by a different vendor with no history of misinstallation of capacitors. There are several failure modes that could have caused the failed on-heater. The exact cause will be determined during failure analysis under CAR 57RF09-010. On STS-56, vernier thruster L5D experienced a failed-on heater. The heater failure was caused by either the heater controller or the temperature sensor. The heater controller was built by the same manufacturer that made the OV-105 thruster controllers. The cause of the failure has not been determined because the failure analysis is still pending at the vendor. There is no safety-of-flight issue associated with a failed-on vernier thruster heater. A vernier thruster heater is a 10-watt heater which is undersized for the application. The temperature of a vernier thruster can not reach dangerous limits with a failed-on heater. CONCLUSION: The failed-on heater on vernier thruster R5D was caused by the heater controller. CORRECTIVE_ACTION: Vernier thruster R5D was removed from the vehicle. Testing duplicated the in-flight problem. The vendor replaced the heater controller. The thruster was retested with good results and reinstalled on the vehicle. The failure analysis of the heater controller is being conducted under CAR 57RF09-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None

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Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-57-V-14	OI - Sensors
MMACS-03	**GMT:**		**SPR** 57RF16	**UA**	**Manager:**
			IPR 61V-0009	**PR**	x38946
					Engineer:

Title: Payload Bay Door Latch Microswitch Anomalies A. Starboard Forward A Release IntermittentB. Centerline 5-8 A Release IntermittentC. Port Forward B Release Intermittent (ORB)

Summary: DISCUSSION: Following the first landing wave-off when the payload bay doors were reopened, the latch-open indication was not obtained for centerline latches 5-8 on system A. Subsequently, the latch-open indication was not obtained for both the starboard forward-bulkhead latches on system A and the port forward-bulkhead latches on system B. In each case, the crew removed power from the actuator drive motors after the single-motor operating time. The drive-motor current traces and redundant limit switches confirmed that the latches were open.

In the order that they failed, each limit switch began to toggle on and off with increasing frequency until the switch indication remained on. Within 30 minutes of the payload bay door opening, all of the switch indications were normal. This was the first time the OV-105 payload bay doors had been re- opened on orbit. Following the second landing wave-off, proper open indications were received from all payload-bay-door latches. Analysis of the flight data revealed that in each of the failed PDU's, the redundant release switch indicated that the latch had released after the dual- motor run time. All of the associated motor control assemblies (MCA's) and multiplexer/demultiplexers (MDM's) were operating nominally at the time of the switch failures. After the vehicle was returned to KSC, a functional test of the latches was performed with no success in duplicating the anomaly. The latch rigging was inspected and no condition was found that could affect the latch-release indication. The internal PDU limit switch rigging can only be checked after the PDU has been removed from the Orbiter and partially disassembled. The centerline PDU mechanical design of the limit switch actuation is different than the bulkhead PDU design. The centerline PDU has two cams rotating on a drive shaft that directly contact each release limit-switch lever. The bulkhead uses a single cam sliding down a worm gear to deflect a switch actuation lever arm that in turn actuates a pair of release limit switches. During the acceptance test procedure (ATP), each PDU is cycled twice at a temperature of -100 degrees F. After rigging the latches in the Orbiter, the PDU's are functionally tested using dual- and single-motor actuation at ambient temperatures. The thermocouples on OV-102 were removed from the latch PDU's following the STS-5 mission. Currently, thermocouples are located on the exterior of the payload bay doors and on the forward bulkhead. Using the PDU temperature data from the early flights, thermal analyses at JSC and Downey have estimated that the temperature of each of the payload bay doors following the first wave-off, was above -50 ?F, which is warmer than the PDU ATP temperature. The temperatures for the door opening following the second wave-off were estimated to be slightly higher than the previous day. CONCLUSION: The cause of the temporary failure of the three latch-open indication release switches is unexplained. However, the following facts strongly suggests that the thermal environment, and its effect on the combined power drive unit (PDU) and latch mechanism, played a role in the anomalies: a. Each switch began indicating properly in the order in which they were opened; b. The failure occurred in two different latch designs; c. Each switch began toggling on and off with increasing frequency until it remained on; d. The second day door temperatures were slightly higher than on the first day. CORRECTIVE_ACTION: Because of the 3/3 criticality of the latch-open indicator switches, with all hardware passing the functional checks, and the inability to duplicate the problem, no hardware will be removed from the vehicle. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. The failure only affected one latch- open indicator in each of the affected PDU's. With the exception of the single instance of the three delayed latch-open indications, the operation of each of the PDU's was nominal for all open and close sequences during the flight. The opening and closing of the payload bay doors is an automatic sequence. A failed-off release indication switch will cause the motor to drive until the motor is powered off. All flight crews are trained to operate the doors and latches manually,and to remove power from a PDU if any of the latch release limit-switches fail to indicate the latch has been released after the single- motor run time. Failure of any PDU limit switch in the off position requires the motors to be stopped manually. A failed-on limit switch will inhibit its corresponding motor from operating. The PDU is able to drive any latch with a single motor should any failure cause the second motor not to operate.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-57-V-15	Active Thermal
EECOM-03	GMT:		SPR 57RF15	UA	Manager:
			IPR 61V-0007	PR	
					Engineer:

Title: Ammonia Boiler Systems A and B Failure to Cool (ORB)

Summary: DISCUSSION: Following landing, the ammonia boiler systems (ABS) A and B failed. Both the primary and secondary controllers of each system failed to control coolant temperatures within the specified limits. Cooling was initialized using the system B secondary controller, and an out-of- specification high temperature was reached after approximately 7 minutes. Subsequently, the ABS was restarted using the system A secondary controller, and an out-of-specification high temperature was reached within 8 minutes. Two restarts were attempted using the primary controllers for both system A and system B, but these attempts were unsuccessful in controlling emperature. Ground personnel connected ground cooling equipment in time to avert an emergency powerdown of the vehicle.

A borescope inspection of the ABS vent line was performed at KSC. An insect was found in the line but no other material was found. Functional runs conducted at KSC could not duplicate the failure. In fact, system A controlled to an out-of-specification low temperature and system B controlled to an out-of-specification high temperature during these runs. Controller functional and electrical continuity checks were also performed with no anomalies noted. The flow control valves and isolation valves were removed and inspected. A contaminant identified as polyethylene oxide was discovered in the primary flow control valves, in the supply manifold, and in the heat-exchanger inlet area. The GSE that was used to service the ABS was also inspected, and no contamination was found in either the GSE or the ammonia supply. Consequently, no definitive conclusions may be reached at this time about the source of the contamination. The ABS pallet was subsequently replaced with a spare pallet. The heat exchanger and primary flow control valves of the spare pallet were verified to be free of contamination. Troubleshooting is currently underway to determine if contamination exists in the ABS of the other Orbiters. The contamination most likely restricted the ammonia flow and prevented the ABS from cooling the freon coolant loops. An updated analysis has shown that the pre-deorbit radiator coldsoak should maintain avionics and cabin air temperatures within limits for about 60 minutes (assuming no payload cooling requirements) postlanding (vs. the original estimate of 30 minutes). A review of postlanding cooling equipment hookup operations revealed that the average time required for this activity is 41 minutes, well within the 60 minute window mentioned above. ABS failures during aborts (RTLS, TAL and AOA) were analyzed for the nominal prelaunch payload bay (PLB) purge temperature of 65 +/- 5 ?F. The results indicate that, even with no ABS cooling, there is sufficient cooling margin available for all three abort cases (although an emergency powerdown would be required upon landing). Occasionally, payload requirements may dictate a higher than nominal prelaunch purge temperature. Consequently, further analyses were performed for ABS failures combined with a prelaunch PLB purge temperature of 78 ?F. The results indicate that there is sufficient cooling margin available for all abort cases, even at these higher prelaunch purge temperatures. CONCLUSION: The failure of the ABS to control the Orbiter coolant temperature was most probably due to the presence of the polyethylene oxide contaminants in the ABS.
CORRECTIVE_ACTION: The ABS pallet was replaced with a spare pallet. The spare pallet was verified free of contamination and the pallets on the other Orbiters will be inspected for contamination. Further failure analysis and inspections will be tracked under CAR 57RF15. In addition, existing Flight Rules which rely on flash

evaporator system (FES) outlet temperatures as a guideline for implementing emergency powerdown procedures will be changed to use the avionics and cabin temperatures instead. Assuming a nominal pre-orbit radiator coldsoak, these temperatures are expected to remain within allowable limits for about 60 minutes (assuming no payload cooling requirements) postlanding. EFFECTS_ON_SUBSEQUENT_MISSIONS: None. The revision to the Flight Rules to base Orbiter postlanding thermal management decisions on the avionics and cabin air temperatures (vs. FES outlet temperatures per the current procedures) will give a 60-minute (assuming no payload cooling requirements) window before ground cooling or an emergency powerdown is required in the event of an ABS failure. This will allow for the average time (41 minutes) for hooking up ground cooling equipment.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-57-V-16	OI - Recorders
None	**GMT:**		**SPR** 57RF17	**UA**	**Manager:**
			IPR	**PR** INS-5-05-0148	x36908
					Engineer:

Title: MADS Recorder Anomaly (GFE) (ORB)

Summary: DISCUSSION: Prior to the deorbit firing of STS-57, the modular auxiliary data system (MADS) recorder (s/n 1005) twice failed to begin recording at 15 inches per second (ips) after the Instrumentation and Communication Officer (INCO) sent the "PCM ON" and "WB/ACIP ON" commands. The commands were sent at approximately 182:11:36 G.m.t. and 182:11:39 G.m.t. A command was sent at approximately 182:11:48 G.m.t. to forward the recorder at 60 ips and was then stopped after the percent-tape indication increased to 10 percent. The "WB/ACIP ON" and "PCM ON" commands were sent at 182:11:54 G.m.t. to drive the tape at 15 ips and the recorder began recording. These failures to begin recording are indicative of a sticky tape.

The MADS recorder was removed and will be replaced with a recorder that has a new tape that is less susceptible to stickiness. CONCLUSION: A sticky tape is suspected to have caused the failures of the MADS recorder to begin recording. The 60-ips forward command produced sufficient torque to move the tape off the sticky spot and subsequent 15-ips recording commands were successful. CORRECTIVE_ACTION: The MADS recorder has been removed and will be replaced with a recorder which has a tape that is less susceptible to stickiness. Recorder s/n 1005 is the last recorder in the field with a tape from the lot that has a known susceptibility to stickiness. The MADS recorder s/n 1005 was returned to the vendor where the recorder will be cleaned and refurbished as required along with the installation of a new tape. The failure analysis will be conducted under CAR 57RF17-010. EFFECTS_ON_SUBSEQUENT_MISSIONS: None.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-57-V-17A & B	TPS
None	**GMT:**		**SPR** 57RF08, 57RF18	**UA**	**Manager:**
			IPR	**PR** V070-5-05-0063 & -	x39037

0061 **Engineer:**

Title: Foam Adhered to 17 inch LH2 Umbilical and LO2 Door (ORB)

Summary: DISCUSSION: During the postlanding inspection of the Orbiter umbilical cavity, foam pieces were found. One piece was found on the LH2 side and one piece was found on the LO2 side.

On the LH2 side, foam from the external tank (ET) was found attached to the LH2 curtain attach plate. The 15-inch piece of foam contained part of the red rubber purge barrier seal and a layer of green Super Koropon primer from the ET half of the umbilical. The foam is believed to have cracked, possibly due to thermal or vibration effects prior to ET separation and adhered to the umbilical attach plate. After removal of the curtain attach plate from the Orbiter half of the umbilical, excess foam was found on the plate. This is located at the position of the 4-inch LH2 recirculation disconnect leak check port. This section of umbilical foam is left open until after ET/Orbiter mating operations to facilitate leak checks. After the leak check is finished, the cavity is filled with pourable foam to insulate the disconnect from heat leaks. This foam acted as a bonding agent to "glue" the red rubber seal and foam section from the ET half to the Orbiter half. When the two halves of the umbilical separated, this piece of foam/red rubber seal remained intact. A room temperature vulcanized(RTV) dam was originally designed to help prevent this bonding action from occurring, but it now appears to be insufficient to prevent a recurrence. Rockwell has released an engineering order(EO) to the foam closeout drawing to clarify the RTV damming/foam closeout application. Sufficient RTV is to be applied to preclude any passages for foam to bond to the curtain attach plate/Orbiter umbilical. This improved application of RTV was used for STS-58 umbilical closeout. On the LO2 side, a loose piece of foam approximately 2 in. square was found on the inboard edge of the ET door seal and the foam showed some evidence of charring from entry heating. The foam appeared to be from the ET disconnect and was confirmed by testing. The entrapped foam occurs during separation when areas of degraded foam break loose and float free becoming captured in the umbilical area. The foam separation is due to outgassing of trapped air within the foam, aerodynamic and vibration abuse on ascent, thermal cycling, and forces that occur due to the ET-Orbiter pyrotechnique separation. With ET- 37 (STS-56), a new polyurethane layer was added around the foam of the umbilical in an effort to prevent degradation on the ground and during ascent. This change was not as effective as originally believed, therefore, other methods are being investigated to prevent foam loss/damage. Rockwell-Downey performed an analysis to ascertain whether foam debris in the LH2/LO2 ET door closure could prevent the door from fully closing. The analysis indicated that the foam will crush or will bend and break from the door-closure forces. The ET door-drive power drive unit (PDU) is capable of 7,000 in-lb, which will provide a minimum crush load capability of 220 lb at the door tip; increasing toward hinge line. The required load to crush a similar piece of foam as experienced on STS-57 is 160 lb. The latch mechanism load capability is greater than 1100 lb which is higher than the door closure hardware. A thermal analysis was performed to determine the maximum door step that would be safe for entry. The analysis indicated that at 0.48-inches, the thermal barrier would maintain contact with the door tiles and prevent hot gas ingestion into the aft fuselage. In addition, there was no evidence of hot gas intrusion in the LO2 ET cavity following the STS-57 postflight inspection CONCLUSION: Due to a processing irregularity, foam was found postlanding on the LH2 umbilical curtain attach plate. Foam found on the LO2 side was due to outgassing of trapped air within the foam, aerodynamic and vibration abuse on ascent, thermal cycling, and forces that occur due to the ET-Orbiter pyrotechnique separation. Foam of a similar size as experienced on STS-57 in both the LH2 and the LO2 umbilical areas can be successfully crushed by the ET door, if this problem should recur on future flights. CORRECTIVE_ACTION: Additional investigation into the foam debonding and Super Korpon debonding will be tracked under CAR 57RF08 and CAR 57RF18.

Rockwell has released an engineering order(EO) to the foam closeout drawing to clarify the RTV damming/foam closeout application. EFFECTS_ON_SUBSEQUENT_MISSIONS: None

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR	IFA STS-57-V-17C	MPS
None	GMT:		SPR	UA	Manager:
			IPR MPS-0296	PR MPS-0296	x39037
					Engineer:

Title: Crack in 17 inch LH2 Curtain Attach Plate (ORB)

Summary: DISCUSSION: Postflight inspection at KSC revealed a 2.5-in. long crack on the LH2 umbilical curtain attach plate that extends completely through the fiberglass. The crack is in an area next to the spacer cut-out and runs diagonally from an area that has two holes that have been filled. The crack propagated in two directions from a filled hole. The filled holes are a part of a spacer modification.

The curtain attach plate is used to provide attach points for the umbilical closeout curtain. The plate is 0.126-in. thick fiberglass-reinforced epoxy with 14 laminations which includes Aluminum foil bonded on one side and a white room temperature vulcanizing(RTV) coating on the other. The attach plate is considered non-structural in its application. The spacer modification was designed to prevent deflection of the 17" disconnect housing which would cause a deflection at the interface between the Orbiter and External Tank(ET) 17" disconnect primary sealing interface. The attach plate was removed and sent to Rockwell for failure analysis. The laboratory failure analysis was performed which indicates that the cause of the crack can be attributed to loads that were applied during tie-bolt tensioning. During this process, loads are applied on the edge between the tie-bolt cutout and the new spacer slot reacting against the Teflon purge barrier seal causing bending of the curtain attach plate. The problem is generic to the 17-inch disconnect spacer modification which affects all vehicles except OV-102. A curtain attach plate repair process is being developed along with a design change to the purge barrier seal material and its configuration. The attach plate is inspected preflight on every vehicle prior to External Tank mating. However, a crack of similar size, if not found, would not affect the umbilical plate gap purge and would have no effect on ET-door closure. CONCLUSION: The crack in the curtain attach plate is a result of loads applied during tie-bolt tensioning. A crack of similar size, if not found, would not affect umbilical plate gap purge and would have no effect on ET-door closure. CORRECTIVE_ACTION: The curtain attach plate was sent to Rockwell for failure analysis. The analysis will be documented on CAR KB2763. The attach plate is inspected preflight on every vehicle prior to ET mating. A curtain attach plate repair process is being developed along with a design change to the purge barrier seal material and its configuration. EFFECTS_ON_SUBSEQUENT_MISSIONS: None

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	MET:	Problem	FIAR B-FCE-029-F071	IFA STS-57-V-19	C&T - Audio
None	GMT:		SPR	UA	Manager:

IPR None **PR**

Engineer:

Title: Wireless Comm Anomaly (GFE) (GFE)

Summary: DISCUSSION: Mission Specialist 2 (MS2) reported during the crew debriefing that a sudden failure of Audio Interface Unit (AIU) C occurred while operating in the radio frequency (RF) mode. MS2 wireless communications were restored by changing to another wall unit. AIU C was removed during normal cabin destowage operations and sent to Houston for failure analysis.

A one-ampere fuse in the AIU's 28-Vdc power input line from the audio terminal unit interface was found to have failed due to excessive current. The AIU was disassembled and the motherboard and individual modules were tested for short- circuits and excessive current draw. No anomalies were found, and no conductive debris was observed that might have created a short-circuit. Precautions were taken during disassembly to assure that all debris, if any, was captured. The AIU was reassembled, a pre-installation acceptance test was completed, and the AIU was returned to service. CONCLUSION: No circuit problem or conductive debris were found that would explain an excessive-current failure of the power-supply line fuse. Possible causes include conductive debris that was not identified during disassembly or an intermittent circuit failure that was not reproduced during troubleshooting. CORRECTIVE_ACTION: The AIU was disassembled and inspected. The motherboard and modules were tested and reassembled. A pre-installation acceptance test was successfully performed, and no problems were found or corrective action taken. Failure analysis closure has been documented in FIAR # B-FCE-029-F071. EFFECTS_ON_SUBSEQUENT_MISSIONS: If the AIU fails again, two crewmembers could lose RF communications capability, and an alternate AIU or an alternate communications system would be selected. There has been no previous occurrence of this failure mode in the history of the program during flight or ground testing.

Tracking No	Time	Classification	Documentation		Subsystem
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-57-V-20	MECH
None	**GMT:**		**SPR** 57RF19, 57RF20	**UA**	**Manager:**
			IPR see corrective action	**PR**	
					Engineer:

Title: CDR, PLT, and MS2 Seat Backs Hard to Adjust. (GFE)

Summary: DISCUSSION: During the STS-57 flight-crew debriefing, the crew mentioned that the seat back on the Commander's seat was very difficult to adjust from the launch position with the seat-back adjusted 10? forward to the on-orbit/entry position.

As a result of the crew comments, the Commander's seat was inspected. The tilt-angle control mechanism on the Commander's seat was found to be missing the lock-nut and two washers, one spherical and one flat, from the end of the control linkage. The missing parts caused the tilt-angle control knob to not effect the seat-back position. However, it is believed that the lock-nut and washers were still attached to the control linkage at the time of the crew complaint because the crew eventually forced the seat into the entry position. With the lock-nut barely attached, it would have been possible for the linkage to move the recline control pin some, but not enough to allow it to be completely disengaged. The crew actions while trying to adjust the seat provided enough force to disengage the pin, thus allowing the seat to be adjusted. The lock-nut would have been able to back off of the linkage rod if, when the seat was assembled, there were not enough threads protruding from the end of the lock-nut to engage the locking feature. Following the flight, both the Commander's and Pilot's seats were removed from the vehicle to perform preplanned modifications. It is not known whether the lock-nut and washers were lost during the flight or during the seat-removal process. None of the missing hardware was located in the Orbiter. As a result of the problem found with the Commander's seat, a similar inspection was performed on the Pilot's seat. This inspection revealed that one half of the spherical washer was missing from the tilt-angle control- linkage mechanism. The spherical washer consists of two washer halves, one half of which is concave and the other which is convex. The two washer halves are placed together so that the curved ends are touching. A regular flat washer is placed between the spherical washer and the lock-nut. This arrangement allows for flexibility in the tilt-angle control mechanism and maintains a constant pressure on the face of the lock-nut. The OV-104 Commander's and Pilot's seats were in Houston undergoing the modifications necessary to meet the 20g crash requirements. Inspections on both of these seats revealed that only half of the spherical washer was installed. The missing half of the spherical washer will be added to the OV- 104 seats during the 20g modification process. As a result of the OV-104 seats also being out-of-configuration, suspect problem reports (PR's) were written to inspect the seats in OV-102 and OV-103 to determine if the spherical washer was installed correctly and to verify that the lock-nuts had a sufficient number of threads protruding from the lock- nut to assure that the linkages would be held together. Three threads protruding is desirable with one and one-half threads considered the minimum necessary to assure that the lock-nut would not back off. The OV-103 inspection revealed that half of the spherical washer was missing from each seat. On the Commander's seat, one and one-half threads were protruding from the lock-nut. On the Pilot's seat, only one-half of a thread was protruding from the lock-nut. Following the STS-51 mission, the missing half of the spherical washer will be added to each seat and the linkage adjusted so that sufficient threads protrude from the end of the lock-nut. The STS-51 crew were briefed on a method to manually disengage the tilt- actuator lock-pin should the linkage come apart in-flight before the seat adjustment to the orbit/entry position is made. The OV-102 inspection also revealed that each seat was missing one-half of the spherical washer. There were four threads protruding from the lock-nut on the Commander's seat and six threads protruding from the Pilot's seat lock-nut. The missing half of the spherical washer was added to each linkage and new lock-nuts were installed. The addition of one-half of the spherical washer resulted in two and a half threads protruding from the lock-nut on the Commander's seat and four threads protruding on the Pilot's seat. The seat assembly drawing does not show or state that the spherical washer consists of two pieces. It is believed that the seat assembly technicians, for both the OV-105 seats and the original manufacturer for the rest of the seats, installed only one-half of the washer and did not realize that each spherical washer consisted of two pieces. The absence of one-half of the spherical washer is considered a life-issue only, and the absence of one-half of the washer does not affect the operation of the tilt-angle control mechanism. The inspections of the flight seats indicate that the second half of the spherical washer was never installed in any seat built. An inspection of the trainer seats is not planned. The crew also commented in the same debriefing session that the Mission Specialist 2 seat was difficult to get out of the launch configuration. As a result of the crew comments on the MS2 seat, all of the passenger seats were inspected and found to operate in all modes. There were no mechanical problems noted with any of the seat adjustment mechanisms on any of the passenger seats by either KSC ground personnel or by JSC subsystem personnel. CONCLUSION: The cause of the difficulty in the seat-back adjustment for the Commander's seat was the lock-nut that secured the tilt-angle control linkage to the tilt-angle control had backed off and allowed the recline control pin to not fully disengage. It is believed that the lock-nut was able to back off due to the improper assembly of the seat that allowed the locking feature of the lock-nut to not be engaged. The Pilot's seat was found to be out-of- configuration by inspection. Again, this condition was caused by improper assembly during manufacture. No mechanical problem was found that would cause the difficulty that the crew experienced when adjusting the Mission Specialist 2 seat, and it is assumed that the seat in question required more force to adjust than the other passenger seats. CORRECTIVE_ACTION: The tilt-angle control mechanism on the Commander's seat was repaired and tested successfully. The linkage required adjustment to assure that the lock-nut had sufficient threads protruding from the end of the lock-nut. The missing half of the spherical washer on the Pilot's seat was replaced, and this repair returned the seat to the proper configuration. With the addition of the missing half of the spherical washer, the linkage required adjustment to assure that three threads protruded from the lock-nut. Half of the spherical washer was found to be missing from each of the remaining Commander's and Pilot's seats in the fleet. The OV-104 Commander's and Pilot's seats will be returned to configuration, with the addition of the other half of the washer, during the 20g beef-up modification. The OV-102 seats have been returned to the proper configuration with the addition of the missing half of the spherical washer to each seat. The OV-103 seats will be returned to the proper configuration following the STS-51 mission. The tilt- angle control linkage will require adjustment in addition to adding the missing half of the spherical washer. No modifications were made to any of the passenger seats. PRs: CDR: FCS-5-05-0171 PLT: FCS-5-05-0172 MS2: MV0610A-3-0025 OV-102 CDR: FCS-2-15-0474 OV-102 PLT: FCS-2-15-0475 OV-103 CDR: FCS-3-17-0506 OV-103 PLT: FCS-3-17-0507 EFFECTS_ON_SUBSEQUENT_MISSIONS: None. Should this condition occur on a future flight, it is possible for the crew to manually release the locking pin.

Tracking No	**Time**	**Classification**	**Documentation**		**Subsystem**
MER - 0	**MET:**	Problem	**FIAR**	**IFA** STS-57-V-21	Hydraulics
None	**GMT:**		**SPR** 57RF14	**UA**	**Manager:**
			IPR	**PR** HYD-0126	x39033
					Engineer:

Title: Hydraulic System 1 Priority Valve Sluggish (ORB)

Summary: DISCUSSION: When the hydraulic system 1 main pump pressure switch was moved to the "Normal" position during entry operations at ~182:12:08:33 G.m.t., the bootstrap accumulator pressure lagged the main pump pressure by 11 seconds before instantaneously rising to an equal pressure. No lag should have occurred in the equalization of these pressures. After pressure equalization, the system performed nominally for the remainder of auxiliary power unit operation.

The priority valve is designed to close when the system is shut down. This valve closure will allow the boot strap accumulator to maintain adequate pressure to assure a good pump restart. When the main pump is restarted the valve opens. Flight data indicated that the hydraulic system 1 accumulator pressure and reservoir pressure tracked each other during the period before and after the lagging occurred, which implies that a check valve internal to the priority valve was sluggish to open. Other such lags have been experienced by priority valves on hydraulic systems on: OV-104 during STS-27, STS-44, and STS-37; OV- 103 during STS-33, STS-29 and STS-41; OV-105 during STS-49. Examinations of these priority valves have revealed contamination and scoring within the priority valve to be the cause of the lags. The contamination is a result of degradation in the accumulator T-seal backup seal. The backup seals are comprised of Carbon filed Teflon. As the seals degrade small particles of Carbon migrate through the system toward the priority valve. CONCLUSION: The delay in hydraulic system 1 accumulator pressure matching the associated main pump pressure was most probably the result of contamination and scoring of the check valve internal to the priority valve which restricted the check valve movement . CORRECTIVE_ACTION: The hydraulic system 1 priority valve was removed and replaced. A failure analysis will be performed to determine the cause of the problem. Improvements to the hydraulic bootstrap system which includes the priority valve are under investigation. EFFECTS_ON_SUBSEQUENT_MISSIONS: None